Incorporating Neuroimaging into Addiction Neuromodulation Research

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Introduction/Issues: Magnetic resonance imaging (MRI) is an objective non-invasive tool that permits high-resolution mapping of the brain. Addiction research is expanding towards novel neuromodulation therapies (e.g. pharmacotherapies, electromagnetic stimulation) that modify maladapted neurobiology. MRI provides a biological basis to aid the development of new treatments, better understand the neurocircuitry involved and the potential impacts of addiction treatment.

Method/Approach: Two neuromodulation pilot projects are incorporating opt-in neuroimaging sub-studies, in Newcastle NSW, and will investigate the use of an mTOR inhibitor (n=12 treatment, n=12 controls) and transcranial magnetic stimulation (n=15 treatment, n=15 controls) for alcohol and methamphetamine use disorders respectively. Scans will occur pre- and post-treatment. Feasibility of conducting MRI sub-studies will be assessed. Areas of interest include reward, craving and cognitive-control associated pathways (cortico-limbic-striatal systems). Structurally, T1 and T2 weighted images will be acquired and synthesised. Tasked-based functional MRI experiments will be performed, cue-exposure and Go/No-Go, to measure networks involved in craving/reward processing, and impulsivity/inhibition respectively. Analyses will involve Dynamic Causal Modelling to causally infer on hidden neuronal states and effective connections between regions to determine relative roles and direction of influence amongst brain regions. Magnetic Resonance Spectroscopy will be integrated to examine neurochemical profile.

Key Findings: Data on the feasibility of incorporating neuroimaging alongside clinical intervention studies will be collected. Important pilot data to enhance our knowledge of the relevant neural correlates and inform the development of larger multi-site trials, will also be obtained.

Discussion and Conclusions: Integrating neuroimaging techniques and analytic methods into treatment development facilitates a greater insight into the pathophysiology and dysregulated neural activity associated with substance use disorders, and the modifying effect treatment may have.

Implications for Translational Research: Research of this nature has the potential to corroborate preclinical neuroscience findings with clinical neurobiological outcomes, aiding the translation of novel treatment options for people with addiction.

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